



Lesson 16

Installing and Configuring Printers

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- Understanding Printer Types and Processes
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Understanding Printer Types and Processes



introduction

Printers are electromechanical output devices that are used to put information from the computer onto paper.

Major type of printer

1. Impact printers
 - i. daisy wheel
 - ii. dot matrix.
2. Bubble-Jet Printer
 - I. Thermal inkjet system
 - II. Piezoelectric Inkjet system
3. Laser printers
 - a) electrophotographic (EP) print process
 - b) light-emitting diode (LED) print process.
4. Other Types of Printers
 - Ø Solid ink
 - Ø Thermal
 - Ø Dye sublimation

1-Impact Printers

Introduction

- Use some form of impact and an inked ribbon to make an imprint on the paper.
- Typewriters are like impact printers.
- Both use an inked ribbon and an impact head to make letters on the paper.
- The major difference is that the printer can accept input from a computer.
- Its receiving instructions one line at a time

There are two major types of impact printers:

1. daisy wheel
2. dot matrix.



i- daisy wheel

- Is the oldest printing technologies in use
- Their speed is rated by the number of characters per second (cps) they can print.

Advantages,

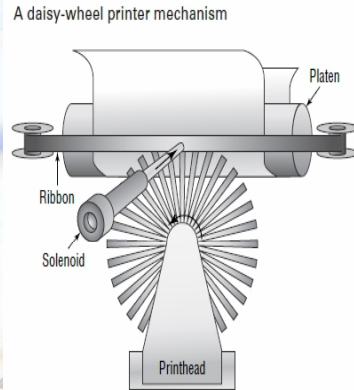
- multipart forms
- relatively inexpensive compared to the price of a laser printer
- Finally, the print quality is comparable to that of a typewriter because it uses a very similar technology. This typewriter level of quality was given a name: *letter quality (LQ)*.

Disadvantages

- Slow .(2 to 4 per second)
- it makes a lot of noise when printing

How its work

- These impact printers contain a wheel with raised letters and symbols on each "petal"
- When the printer needs to print a character, it sends a signal to the mechanism that contains the wheel. This mechanism is called the printhead.
- The printhead rotates the daisy wheel until the required character is in place.
- An electromechanical hammer (called a solenoid) then strikes the back of the petal containing the character. The character pushes up against an inked ribbon that ultimately strikes the paper, making the impression of the requested character.

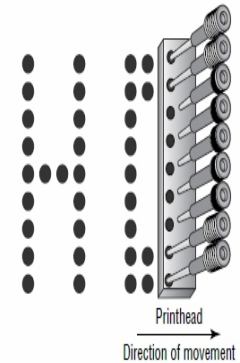


ii- Dot-Matrix Printers

How its work

- The basic principle of a dot-matrix printer is that a collection of pins, typically 9 or 17 or 24, organized in a rectangular shape, are pressed against a ribbon,
- higher the number of pins the higher the print quality.
- The pins in the printhead are wrapped with coils of wire
- the printer controller sends a signal to the printhead, which energizes the wires around the appropriate print wire.
- This turns the print wire into an electromagnet, which repels the print pin, forcing it against the ink ribbon and making a dot on the paper.

Formation of images in a dot-matrix printer



Advantages & disadvantage

Advantages

- can use multipart forms
- quieter than daisy-wheel printers (ballistic cover)
- Faster speed than daisy-wheel printers typically in the range of 36 to 72cps). Some dot-matrix printers (like the Epson DFX series) can print at close to a page per second!

Disadvantage

- The main disadvantage of dot-matrix printers (9 pin) is their image quality, which can be quite poor compared to the quality produced with a daisy wheel. (*draft quality*)

Note (17-24 pin) *near letter quality (NLQ)*.

2- Bubble-Jet Printers

1-inkjet printers

- Inkjet printers offer the next highest level of print quality and are relatively cheap compared to laser printers.
- Inkjet printers are great for home use or small office environments that don't have large print jobs
- *inkjet printers* spray ink on the page, but inkjet printers used a reservoir of ink, a pump, and an ink nozzle to accomplish this. They were messy, noisy, and inefficient.

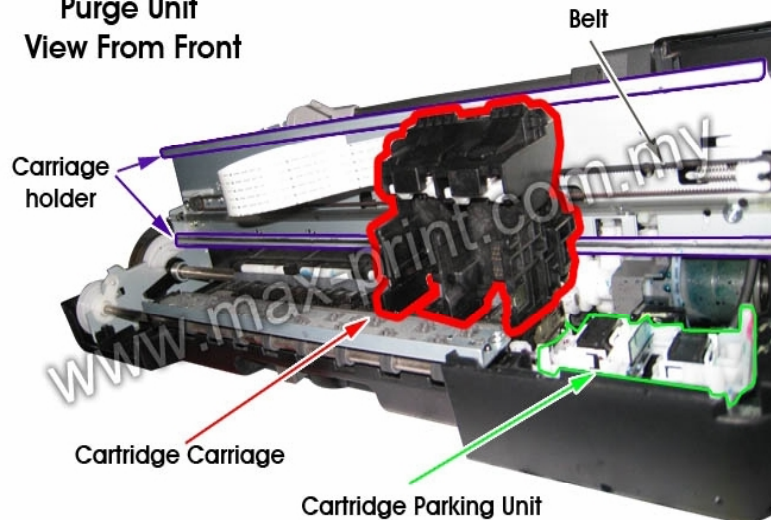
Bubble-Jet Printer

- This category is an advanced form of an older technology known as ***inkjet printers***.
- Bubble-jet printers work much more efficiently and are much cheaper.

Parts of a Typical Bubble-Jet Printer

1. Printhead / ink cartridge
2. Head carriage,
3. stepper motor
4. Belt
5. *Maintenance station*
6. Paper-feed mechanism
7. Control, interface, and power circuitry

Purge Unit
View From Front

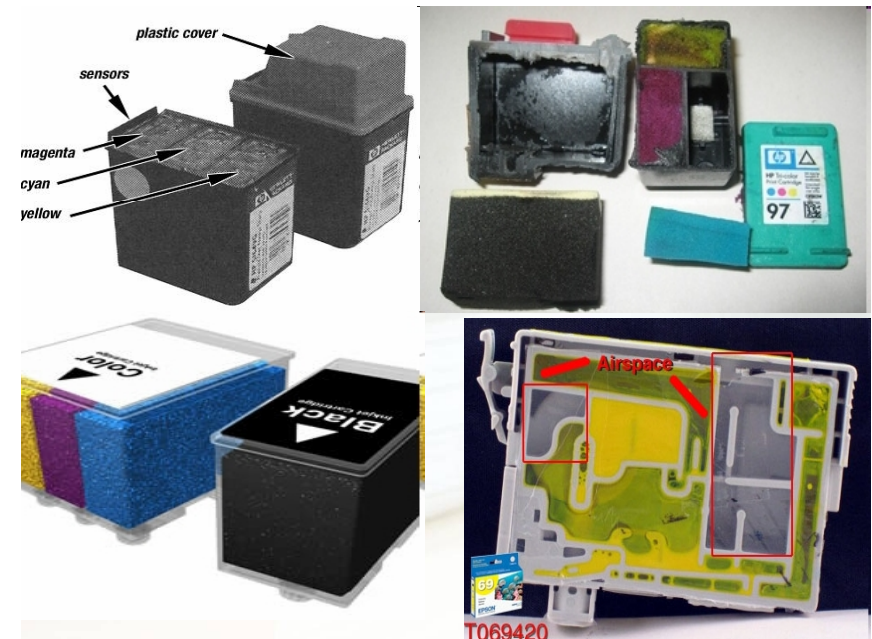
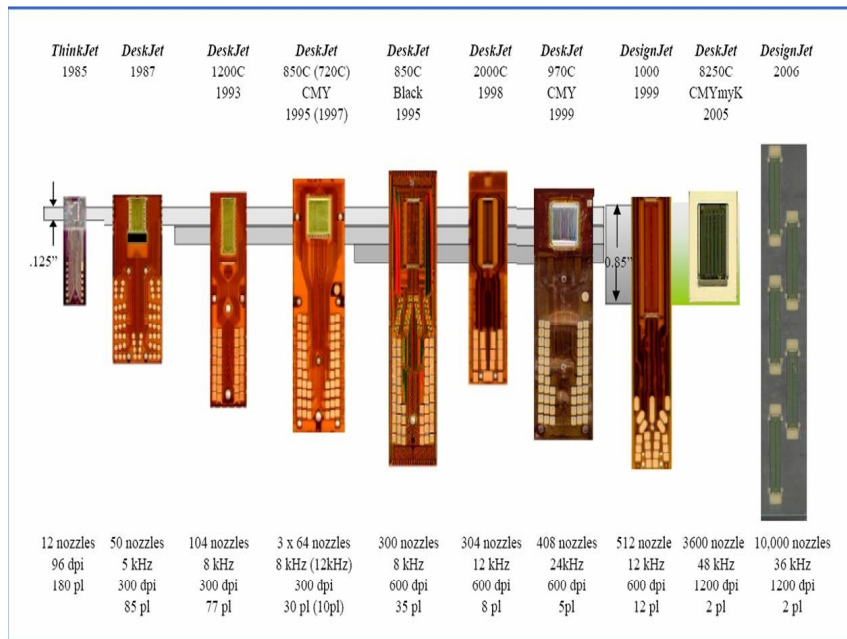


Prepare by Maxprint

1-Printhead / ink cartridge

- *Printhead* contains many small nozzles (usually 100–200) that spray the ink in small dots onto the page.
- More number of nozzle means higher printer resolution
- These nozzles are typically about 10 micrometers in diameter (roughly 1/10th of the diameter of a human hair)
- Color bubble-jet printers include multiple printheads, one for each of the *CMYK* (*cyan, magenta, yellow, and black*) print inks.
- Many times the printhead is part of the ***ink cartridge***, which contains a reservoir of ink and the printhead in a removable package.
- Inside the ink cartridge are several small chambers. At the top of each chamber are a metal plate and a tube leading to the ink supply.





There are two methods of spraying the ink out of the cartridge.

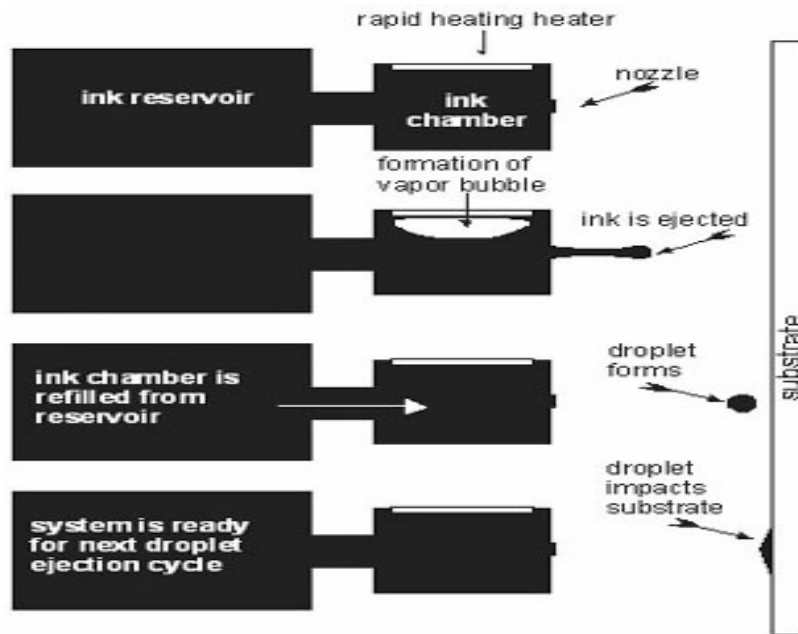
I. Thermal inkjet system

II. Piezoelectric Inkjet system

I- Thermal inkjet system

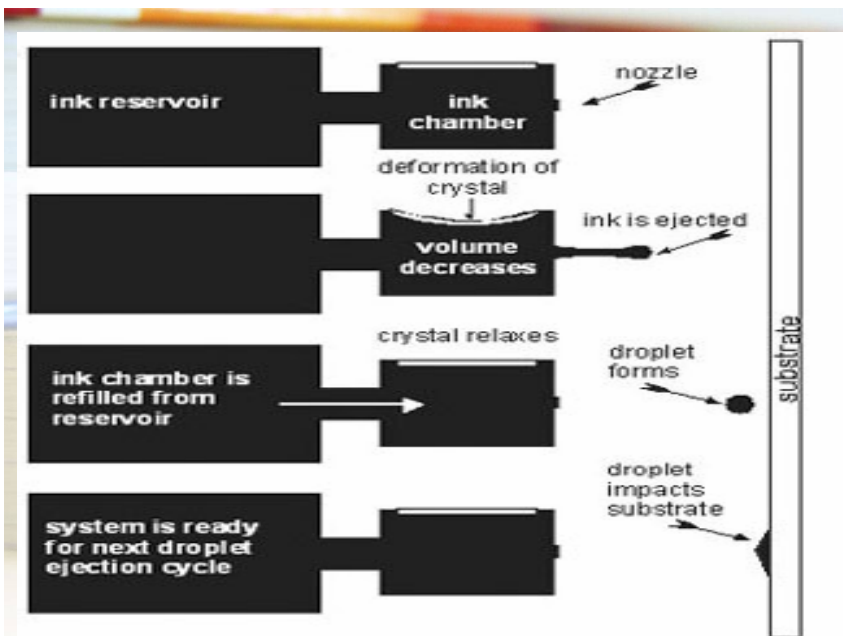
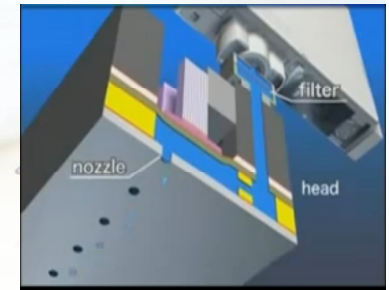
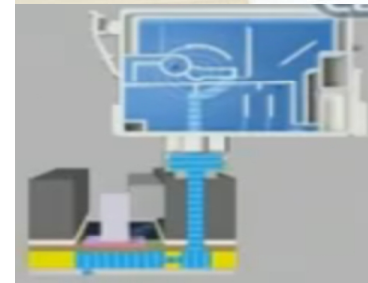
- Developed by Hewlett-Packard (HP):
when a particular chamber needs to spray ink, an electric signal is sent to the heating element, energizing it. The elements heat up quickly, causing the ink to vaporize. Because of the expanding ink vapor, the ink is pushed out the pinhole and forms a bubble. As the vapor expands, the bubble eventually gets large enough to break off into a droplet. The rest of the ink is pulled back into the chamber by the surface tension of the ink. When another drop needs to be sprayed, the process begins again.





II- Piezoelectric Inkjet system

- developed by Epson, uses a piezoelectric element that flexes when energized.
- The outward flex pushes the ink from the nozzle; on the return, it sucks more ink from the reservoir.
- When the printer is done printing, the printhead moves back to its maintenance station.



2- Head Carriage,

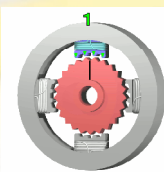
- The *printhead carriage* is the component of a bubble-jet printer that moves back and forth during printing.
- It contains the physical as well as electronic connections for the printhead.
- Note the clips that keep the ink cartridge in place and the electronic connections for the ink cartridge.
- These connections cause the nozzles to fire, and if they aren't kept clean, you may have printing problems.
- To keep the printhead carriage aligned and stable while it traverses the page, the carriage rests on a small metal *stabilizer bar*.



3- Stepper Motor

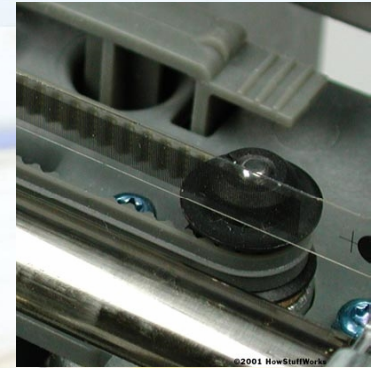
carriage motor

- The stepper motor and belt make the printhead carriage move.
- A stepper motor is a precisely made electric motor that can move in the same very small increments each time it is activated.
- That way, it can move to the same position(s) time after time.



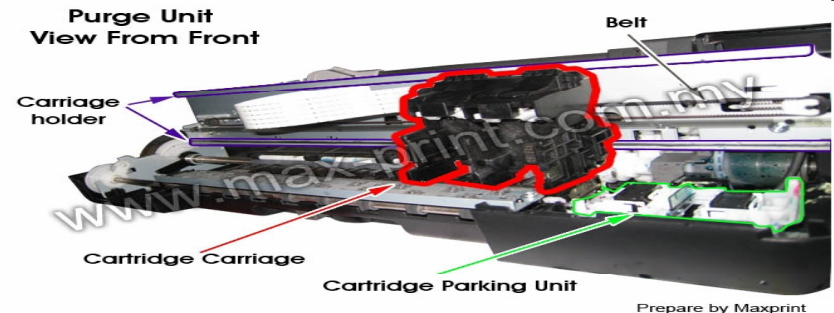
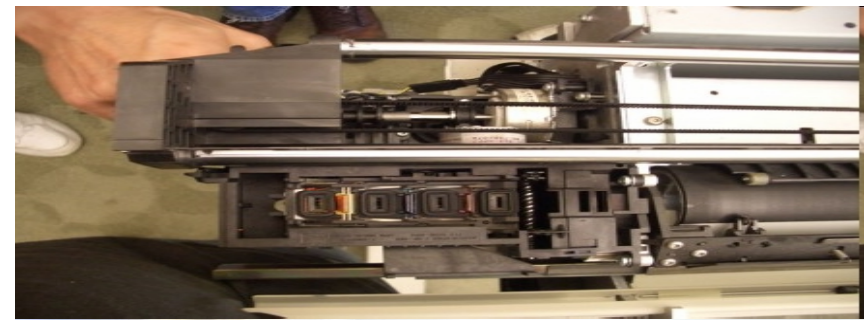
4- carriage belt

- In addition to the motor, a belt is placed around two small wheels or pulleys and attached to the printhead carriage.
- *is a belt driven by the carriage motor* and moves the printhead back and forth across the page while it prints.
- To keep the printhead carriage aligned and stable while it traverses the page, the carriage rests on a small metal stabilizer bar.



5- Maintenance station

- The *maintenance station* contains a small suction pump and *ink-absorbing pad*.
- To keep the ink flowing freely, before each print cycle the maintenance station pulls ink through the ink nozzles using vacuum suction.
- This expelled ink is absorbed by the pad.
- The station serves two functions:
 1. to provide a place for the printhead to rest when the printer isn't printing
 2. to keep the printhead in working order.

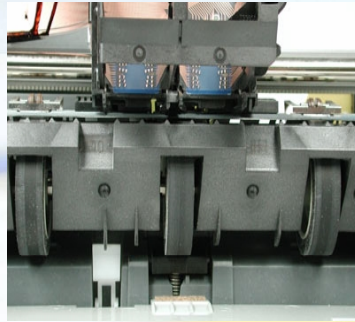


6- Paper-Feed Mechanism

- The *paper-feed mechanism* picks up paper from the paper drawer and feeds it into the printer.

- This assembly consists of several smaller assemblies.**

- pickup rollers* which are several rubber rollers with a slightly flat spot; they rub against the paper as they rotate, and feed the paper into the printer.
- separator pads* is small cork or rubber patches which help keep the rest of the paper in place (so only one sheet goes into the printer).
- paper-feed sensors* tell the printer when it is out of paper, as well as when a paper jam has occurred during the paper-feed process.



Clean pickup rollers (and other rubber rollers) with mild soap and water and not alcohol. Alcohol can dry out the rollers, making them ineffective.

- paper tray* which is simply a small plastic tray in the front of the printer that holds the paper until it is fed into the printer by the paper-feed mechanism.
- On smaller printers, the paper is placed vertically into a paper feeder at the back of the printer; it uses gravity, in combination with feed rollers and separator pads, to get the paper into the printer.
- Generally, more expensive printers use paper trays, because they hold more paper.



7- Control, Interface, and Power Circuitry

- The *printer control circuits* are usually on a small circuit board that contains all the circuitry to run the stepper motors the way the printer needs them to work (back and forth, load paper and then stop, and so on). These circuits are also responsible for monitoring the health of the printer and reporting that information back to the PC.
- interface circuitry* (commonly called a port), makes the physical connection to whatever signal is coming from the computer (parallel, serial, SCSI, network, infrared, and so on) and also connects the physical interface to the control circuitry. The interface circuitry converts the signals from the interface into the datastream that the printer uses.

- power circuits* convert 110V or 220V house current into the voltages the bubble-jet printer uses (usually 12V and 5V) and distribute those voltages to the other printer circuits and devices that need it. This is accomplished through the use of a transformer. A transformer, in this case, takes the 110V or 220V AC current and changes it to 12V DC (among others). This transformer can be either internal (incorporated into the body of the printer) or external.

The Bubble-Jet Printing Process

1. You click the Print button (or similar) that initiates the printing process.
2. The software you are printing from sends the data to be printed to the printer driver you have selected.
3. The printer driver uses a page-description language to convert the data being printed into the proper format that the printer can understand. The driver also ensures that the printer is ready to print.
4. The printer driver sends the information to the printer via whatever connection method is being used (USB, network, parallel, and so on).

5. The printer stores the received data in its onboard print buffer memory. A print buffer is a small amount of memory (typically 512KB to 16MB) used to store print jobs as they are received from the printing computer.
This buffer allows several jobs to be printed at once and helps printing to be completed quickly.
6. If the printer has not printed in a while, the printer's control circuits activate a cleaning cycle.
A cleaning cycle is a set of steps the bubble-jet printer goes through in order to purge the printheads of any dried ink.
It uses a special suction cup and sucking action to pull ink through the printhead, dislodging any dried ink or clearing stuck passageways.
7. Once the printer is ready to print, the control circuitry activates the paper-feed motor. This causes a sheet of paper to be fed into the printer until the paper activates the paper-feed sensor, which stops the feed until the printhead is in the right position and the leading edge of the paper is under the printhead.
If the paper doesn't reach the paper-feed sensor in a specified amount of time after the stepper motor has been activated, the Out of Paper light is turned on and a message is sent to the computer.

8. Once the paper is positioned properly, the printhead stepper motor uses the printhead belt and carriage to move the printhead across the page, little by little.
The motor is moved one small step, and the printhead sprays the dots of ink on the paper in the pattern dictated by the control circuitry.
Typically, this is either a pattern of black dots or a pattern of CMYK inks that are mixed to make colors.
Then the stepper motor moves the printhead another small step; the process repeats all the way across the page
9. At the end of a pass across the page, the paper-feed stepper motor advances the page a small amount.
Then the printhead repeats step 8. Depending on the model, the printhead either returns to the beginning of the line and prints again in the same direction only, or it moves backward across the page so that printing occurs in both directions. This process continues until the page is finished.

10. Once the page is finished, the feed-stepper motor is actuated and ejects the page from the printer into the output tray. If more pages need to print, printing the next page begins again at step 7.
11. Once printing is complete and the final page has been ejected from the printer, the printhead is parked (locked into rest position) and the print process is finished.



Laser Printers



Laser Printers Types

- Laser printers and inkjet printers are referred to as *page printers* because they receive their print job instructions one page at a time (rather than receiving instructions one line at a time).

There are two major types of page printers:

1. Those that use the electrophotographic (EP) print process
 2. Those that use the light-emitting diode (LED) print process.
- Each works in basically the same way, with slight differences.

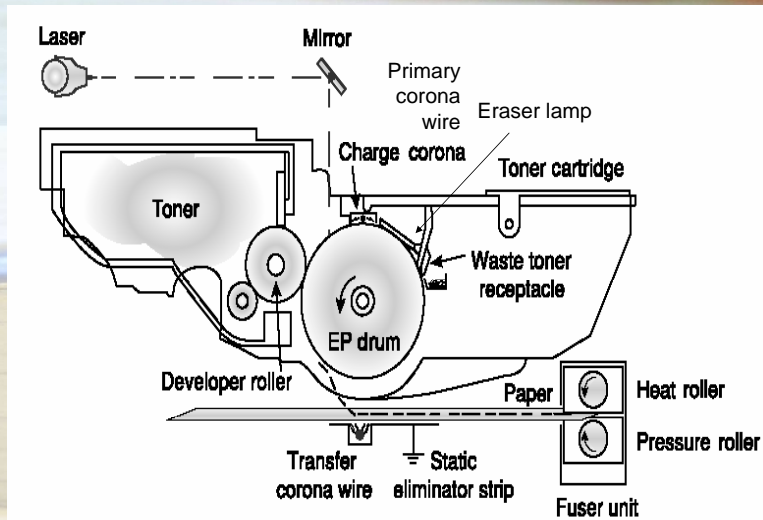


Electrophotographic (EP) Laser Printers



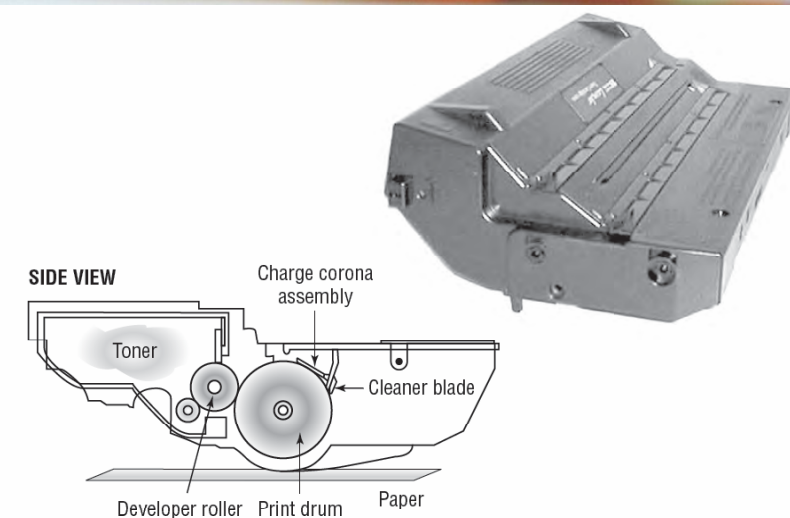
Laser Printer Components

1. EP toner cartridge Toner
2. Photosensitive drum
3. Eraser lamp
4. Primary corona
5. Transfer corona
6. Laser
7. Fuser
8. Printer controller
9. Ozone Filter
10. Paper-Transport Assembly



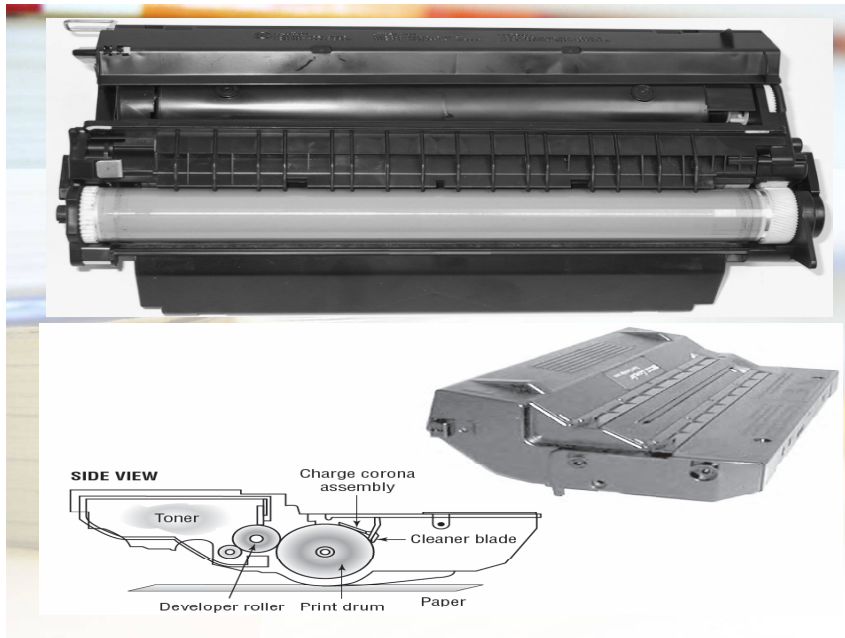
1- EP toner cartridge Toner

- The EP toner cartridge as its name suggests, holds the toner.
- Toner is a black carbon substance mixed with polyester resins (to make it flow better) and iron oxide particles
- In addition to these components, toner contains a medium called the developer (also called the *carrier*), which carries the toner until it is used by the EP process.
- The toner cartridge also contains the EP print drum.



2-Photosensitive drum / EP drum (electrostatic photographic drum)

- The **photosensitivity** comes from the fact that the roller is **coated** with specialized **photosensitive particles**.
- A **laser beam** inside the printer **shines reflected light onto the surface of the drum**, creating a pattern of electrically charged, and not so charged, areas. The end result is an image on the drum to be transferred to paper.
- The drum is usually held **inside the toner cartridge**, but **can be accessed** in case it needs to be manually cleaned to remove excess toner.
- When handling or wiping the drum, use extra caution; any **scratches or dents** on the drum will be **evident on every print job**. The only remedy is to **replace the drum**, which normally involves **replacing the entire toner cartridge**.
- drum contains a cleaning blade that continuously scrapes the used toner off the photosensitive drum to keep it clean.



3- Eraser lamp

- The eraser lamp is used to give the photosensitive drum a thorough electrical **cleaning**.
- The eraser lamp **shines a light** on the **entire surface** of the photosensitive drum, **neutralizing the electrical charge**.
- This is done to **remove** any remaining **particles** from the drum before the next print job.

4- Primary corona (charging corona)-

- The primary corona is a special wire or roller that rests very close to the **photosensitive drum**, but never actually touches the drum.
- The primary corona wire is responsible for **negatively** charging the photosensitive

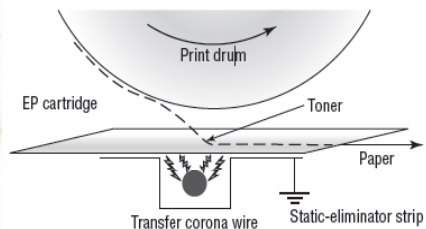
5- Transfer corona+

- The transfer corona is responsible for **positively** charging the **paper** before it reaches the toner area.
- To get the image from the drum onto the paper, the paper must have a positive electrical charge that will draw the toner away from the drum and onto the paper.
- To prevent the positively charged paper from sticking to the drum itself, a **static charge eliminator** is used to remove the charge from the paper.

There are two types of transfer corona assemblies:

- The **transfer corona wire** is a small-diameter wire that is charged by the HVPS. The wire is located in a special notch in the floor of the laser printer (under the EP print cartridge).
- The **transfer corona roller** performs the same function as the transfer corona wire, but it's a roller rather than a wire. Because the transfer corona roller is directly in contact with the paper, it supports higher speeds.
- For this reason, the transfer corona wire is no longer used much in laser printers.

The transfer corona assembly



6- Laser

- The laser beam is used in the **writing process and creates an image of the page** to be printed on the photosensitive drum.
- The photosensitive drum holds an electrical charge when not exposed to light.
- Because it is completely dark within the toner cartridge, when the laser hits areas on the drum, the **drum discharges in the areas** hit by the laser, leaving the image.

7- Fuser

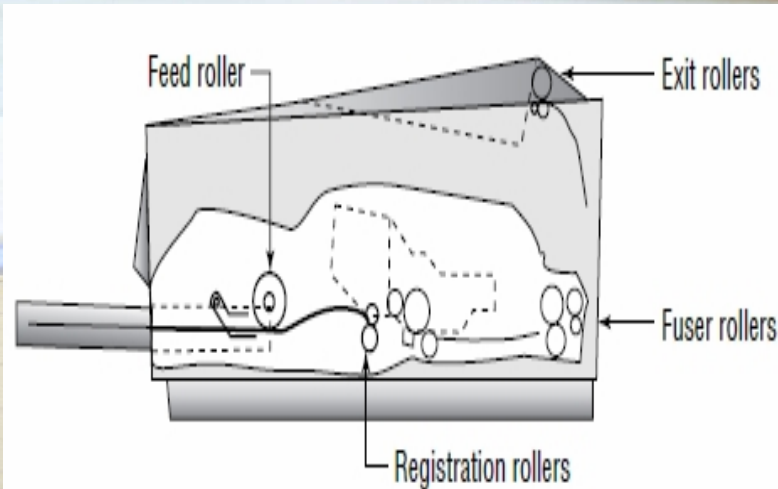
- If you were to touch a printed piece of paper after it leaves the laser printer, you would notice that it **is warm**, (unless you are wearing gloves).
- This is a result of the fusing process. When the toner initially transfers from the drum to the paper, it is only held there by an electrical charge. The fuser effectively melts the toner to the paper.
- When **working inside a printer**, care should be taken to **avoid contact with the fuser** because it gets very hot.

8- Printer controller

- The controller is a **motherboard** equivalent for laser printers; it converts the signals and messages from the computer to signals for the various components within the printer.
- Essentially, the controller is a circuit board that holds the **printer's memory** and communicates with the PC.

9-Ozone Filter

- Your laser printer uses various high-voltage biases inside the case. And high voltages create ozone.
- Ozone is a chemically reactive gas that is created by the high-voltage coronas (charging and transfer) inside the printer. Because ozone is chemically reactive and can severely reduce the life of laser printer components, most laser printers contain a filter to remove ozone gas from inside
- the printer as it is produced.
- This filter must be removed and cleaned with compressed air
- Periodically
- Most newer laser printers don't have ozone filters. This is because these printers don't use transfer corona wires but instead use transfer corona rollers, which dramatically reduce ozone emissions



10- Paper-Transport Assembly

- The paper-transport assembly is responsible for moving the paper through the printer.
- It consists of a stepper motor and several rubberized rollers that each performs a different function.
- **Feed roller, or paper-pickup roller**
This D-shaped roller, when activated, rotates against the paper and pushes one sheet into the printer. This roller works in conjunction with a special rubber separator pad to prevent more than one sheet from being fed into the printer at a time.
- **registration roller**
There are actually two registration rollers, which work together. These rollers synchronize the paper movement with the image-formation process in the EP cartridge.
- **Fuser roller**
• To make the toner melt, the paper

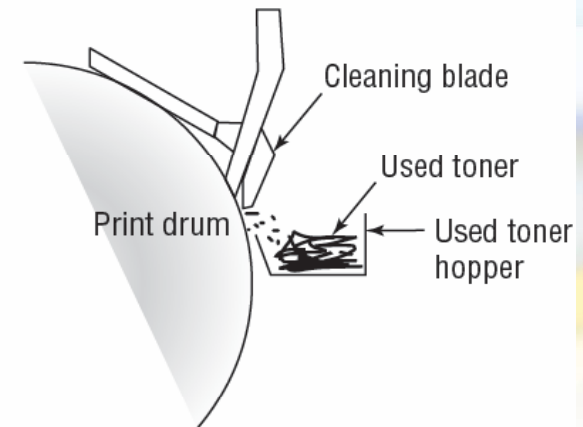
The Electrophotographic Print Process

1. Cleaning Phase
2. Conditioning/Charging the Drum
3. Writing
4. Developing
5. Transferring
6. Fusing

1- Cleaning Phase

- Two things must happen, a physical and an electrical cleansing.
- 1. The **physical cleaning** is accomplished by a **rubber blade** that effectively scrapes off the excess toner from the drum, similar The extra toner is collected in a toner receptacle inside the toner cartridge. The extra toner will just sit there until the toner cartridge is replaced.
- 2. **remove the electrical charge.** **eraser lamp**(Fluorescent lamp) shines on the drum, causing it to lose all of its electrostatic charge.
Fluorescent lamp discharges any remaining charge on the photosensitive drum.
- If the drum is **not being effectively cleaned**, the result is **poor print quality**, which would manifest itself as residue on the printout from previous printed pages (ghost).
- In some cases, if it happens a lot, the **drum might** need to be changed, or the **eraser lamp** replaced.

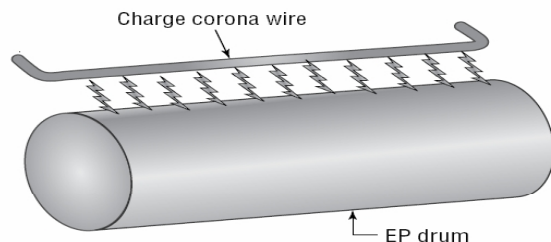
The cleaning step of the EP process



2- Conditioning/Charging the Drum-

- In this step, a special wire or roller (called a charging corona) within the EP toner cartridge (above the photosensitive drum) gets a high voltage from the HVPS.
- It uses this high voltage to apply a strong, uniform negative charge (around -600VDC) to the surface of the photosensitive drum.

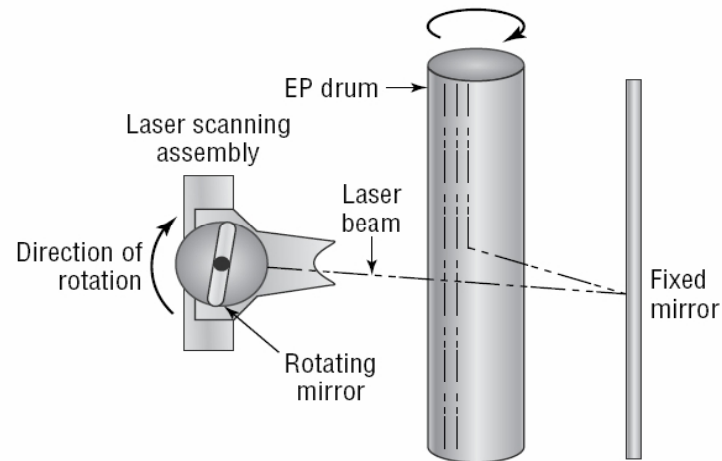
The charging step of the EP process



3- Writing

- The **laser beam** flashes on and off as directed by the information sent to it as a print job.
- The beam reflects off **of mirrors** to hit the drum. Wherever the laser beam hits the photosensitive drum, the negative charge is reduced from its **-600 volt plateau to -100 volts**, creating an image on the drum.
- After the laser light does its job, the drum holds an electrical representation of the image to be printed.
- At this point, the controller sends a signal to the pickup roller to feed a piece of paper into the printer, where it stops at the registration rollers.

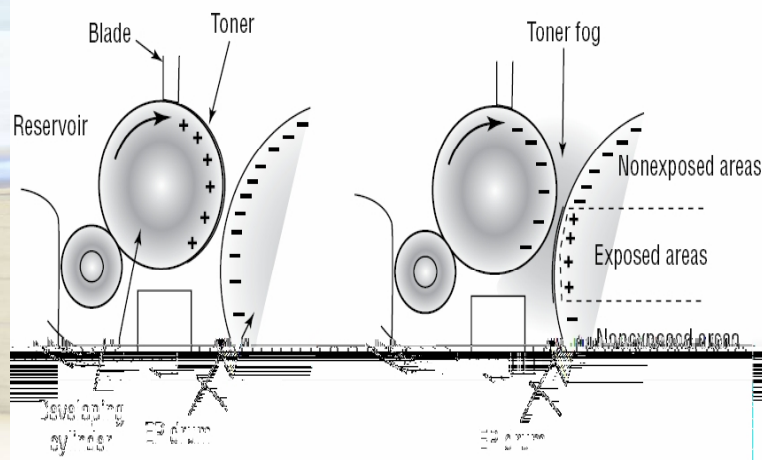
The writing step of the EP process



4- Developing

- After the image has been created on the photosensitive drum, the toner is used to develop the image on the drum.
- Alongside the print drum is a roller called the *developing roller*.
- The developing roller has a $-600V$ charge, which attracts the toner from the toner reservoir to the developing roller.
- Because the print drum and the developing roller are both charged with $-600V$ (except for the areas of the print drum previously exposed to laser light), the toner from the developing roller is attracted to the $-100V$ charged areas of the print drum.
- This entire concept is based on the “opposites attract” principle. Although both the drum and the roller are both negatively charged, $-100V$ is more positive than $-600V$, so the toner on the $-600V$ roller is attracted to $-100V$ areas on the drum.
- Now that the print drum has toner on only the areas of $-100V$ charge, the image is ready for transfer to paper.

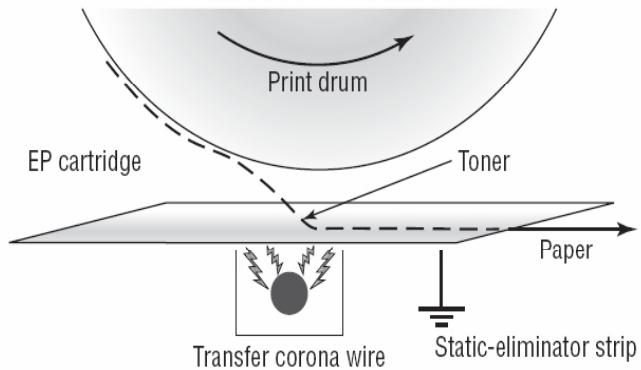
The developing step of the EP process



5- Transferring

- In this phase, the image is transferred from the drum to the paper.
- To do this, the **transfer corona** gives the paper a **positive charge** ($+600VDC$) that attracts the negatively charged toner from the surface of the drum to the positively charged paper.
- In effect, the toner leaps from the drum to the paper. The image, however, is only held on the paper by a **weak static charge**. To fix it more securely, it needs to be fused to the paper.
- Once the registration rollers move the paper past the corona wire, the static-eliminator strip removes all charge from that line of the paper.

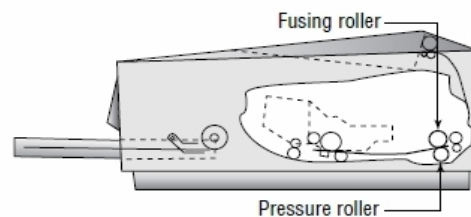
The transferring step of the EP process



6- Fusing

- The fuser is made up of three main parts: a halogen heating lamp, a Teflon-coated aluminum fusing roller, and a rubberized pressure roller.
- The fuser uses the halogen lamp to heat the fusing roller to between 329° F (165° C) and 356° F (180° C). As the paper passes between the two rollers, the pressure roller pushes the paper against the fusing roller, which melts the toner into the paper, causing it to stick (or fuse) to the paper.

The fusing step of the EP process



PPM

- Although the process we have just described seems long and complex, today's laser printers are able to perform the entire process in just a few seconds. Modern high-performance laser printers can turn out upward of **32 pages per minute**, or PPM. If you figure it out, that means the laser printer is going through the six-step process in a little under two seconds.



LED Page Printer Toner Cartridges

- The only difference
 1. the designers of LED page printers made the photosensitive drum and toner separate, because the problem with laser printers is that the toner usually runs out before the photosensitive drum needs to be replaced.
 2. These printers are basically the same as EP process printers, except that in the writing step, they use LEDs instead of a laser.
 - several benefits
 - much cheaper than similar laser printers
 - because the LEDs are close to the drum, the whole printer is smaller—about two-thirds the size of a comparable laser printer.
 - Finally, LEDs aren't as dangerous to the eye as lasers
- **If they have so many advantages, why isn't everyone using them?**
Mainly because
 - LED technology isn't as advanced as laser technology. The resolutions of LED page printers have yet to break the 800 dots per inch (dpi) mark.
 - toner system in an LED printer, although more efficient, is also messier. Because of its slight static charge, toner isn't easy to remove from surfaces.



note

- Never ship a printer anywhere with a toner cartridge installed!
- If the printer is a laser printer, remove the toner cartridge first.
- If it's an LED page printer, there is a method to remove the photosensitive drum and toner hopper (check your manual for details).



Other Types of Printers

- The three other major types of printers in use today are as follows:

1. Solid ink
2. Thermal
3. Dye sublimation

- Keep in mind throughout this section that for the most part, these printers operate like other printers in many ways:

- They all have a paper-feed mechanism (sheet-fed or roll);
- They all require consumables;
- they all use the same interfaces, for the most part, as other types of printers;
- they are usually about the same size.

1-Solid ink

- Solid-ink printers work much like bubble-jet printers. However,
 1. in a solid-ink printer, the ink is in a **waxy solid form** rather than in liquid form, which allows it to stay fresh and not cause problems like spillage.
 2. In addition, solid-ink printers usually print an entire line at one time, which makes them **faster** than bubble-jet printers.
- Because of the type of ink used, solid-ink printers are better for graphics companies that need true color at a price lower than a color laser printer.

2-Thermal

heat-sensitive paper.

- found in many older fax machines
- print on a kind of special, waxy paper that comes on a roll the paper turns black when heat passes over it
- When it needs to print, the printhead heats and cools spots on the printhead. The paper below the heated printhead turns black in those spots.

Using heat-sensitive ribbon

- uses a heat-sensitive ribbon instead of heat-sensitive paper.
- A thermal printhead melts wax based ink from the ribbon onto the paper. These are called thermal transfer or thermal wax-transfer printers.

Advantages

- Thermal direct printers typically have long lives because they have few moving parts.

disadvantages

- the paper is somewhat expensive
- The paper doesn't last long (especially if it is left in a very warm place, like a closed car in summer)
- produces poorer-quality images

3-Dye sublimation

- These printers use sheets of solid ink that *sublimate, or go from the solid phase directly to gas*.
- During printing, a printhead passes over these sheets (one each of cyan, magenta, yellow, and gray for tonal change) inside the printer.
- As it passes over the page, spots on the printhead heat up, causing the ink under those spots to sublimate into gas.
- This gas then passes through the paper being printed, where the ink turns back into a solid, embedded into the paper.
- The printhead in most printers makes four passes, one for each color.
- high quality photo-quality images.
- They take time to produce their images,
- expensive and impractical to use a dye-sublimation printer for word processing.

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و علمني ما ينفعني
وارزقني علما ينفعني